

CHROMOSOME NUMBERS IN *THYMOPHYLLA* (COMPOSITAE: TAGETEAE)

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ABSTRACT

Chromosome numbers in *Thymophylla tenuiloba* var. *tenuiloba* and congeners are evidently all based on $x = 8$. Past reports of $n = 13$ for taxa referable to *Thymophylla* probably resulted from incorrect interpretations of meiotic figures in triploids with $2n = 3x = 24$. Reproduction in the triploids is apparently apomictic.

Johnston and Turner (1962) reported *Thymophylla tenuiloba* (DC.) Small (as *Dyssodia tenuiloba*) to have two chromosome numbers: $n = 8$ and $n = 13$. I accepted Johnston and Turner's observations and reported, myself, chromosome counts of $n = 8, 13, 13 + \text{fragment}, \text{ca. } 13, 16, \text{ca. } 16, \text{ca. } 20, \text{ and } 26$ for *Thymophylla tenuiloba* var. *tenuiloba* (as *Dyssodia*; Strother 1969).

But, also in 1969, I began to doubt the counts of $n = 13$ and $n = 26$. I had discovered that some plants of *Thymophylla tenuiloba* were triploid with $2n = 3x = 24$ and that tetraploid ($2n = 32$) individuals were also present in some local populations. And, I had realized that because some species of *Dyssodia* do have somatic chromosome numbers of $2n = 26$, it had been easy, at least for me, to see what I expected to see, to misinterpret meiotic figures in $2n = 3x = 24$ triploids as "13 sticky pairs."

My first public report of these observations was in an oral presentation (Strother 1970) in which I acknowledged that my earlier reports of $n = 13$ and $n = 26$ for *T. tenuiloba* were doubtless mistaken interpretations of meiotic figures in triploid and higher polyploid plants. I also suggested that other reports of $n = 13$ from those species of *Thymophylla* (i.e., part of *Dyssodia* sensu Strother 1969) for which $n = 8$ had also been recorded were similarly based on erroneous interpretations of triploids.

Flyr (1973) reported my observation that an adventive population of *T. tenuiloba* var. *tenuiloba* (as *Dyssodia*) contained triploids.

In 1975 (see Strother 1977), I reported that triploids were common in *T. tenuiloba* var. *tenuiloba* and that circumstantial evidence (see following) strongly suggested apomictic seed production in the triploids and perhaps in other polyploids of *T. tenuiloba*. In the same paper I pointed out a similar pattern of triploidy in *Porophyllum scoparium* A. Gray (citing Johnson

1969), also a member of Tageteae. In 1976, I noted a second instance of triploidy in *Porophyllum* and reported triploidy in *Chrysactinia mexicana* A. Gray (Strother 1976), also referable to Tageteae. Apomictic triploidy is apparently a recurrent theme in reproductive biology of Tageteae.

In all of these triploids, pollen stainability and pollen production are relatively low, or even nil, and seed-set is consistently high. In *T. tenuiloba* var. *tenuiloba*, for example, stainability of pollen (in lactophenol cotton-blue) ranges from 40 to 100 % in diploids ($N = 62$) with 46 of the 62 individuals scored having stainabilities above 70 %. The range of stainabilities is 0 to 27 % in triploids ($N = 60$) with 45 of the 60 below 10 %; the range is 0 to 82 % in tetraploids ($N = 66$). In diploids, pollen-grains-per-floret averages ca. 4000; in triploids pollen-grains-per-floret ranges from ca. 2000 to virtually (or actually) zero—in some triploid individuals, anther development ceases in some florets before any pollen is produced! Triploid plants in nature and bagged heads of triploid plants (pollen production and stainability not checked) grown under glass in Berkeley produce full complements of plump achenes.

In 1986, I indicated again my belief that chromosome numbers in all members of *Thymophylla* are based on 8 and that the reports of $n = 13$ for plants referable to *Thymophylla* were misinterpretations. Some colleagues have expressed (in litt. and viva voce) reluctance to accept my 1986 circumscriptions of *Dyssodia*, *Thymophylla*, et al. Their reluctance seems to stem, at least in part, from continued belief that some species of *Thymophylla* (sensu Strother 1986) have gametic chromosome numbers of both 8 and 13 or that some species of the genus have $n = 8$ and others have $n = 13$. For the record, then, I feel I should present the following brief summary of my observations on chromosome numbers in *T. tenuiloba* and some of its congeners.

Altogether, I have studied meiotic configurations of chromosomes in some 443 individuals from 82 sites from across most of the natural and much of the adventive range of *Thymophylla tenuiloba* var. *tenuiloba*. The distinction between natural and adventive ranges of *T. tenuiloba* var. *tenuiloba* is based on cumulative mapping of collections in chronological sequence up to selected dates (cf. figure 1). Local populations in areas beyond the range as known through ca. 1940 are restricted to immediate shoulders of roadways, do not appear to be part of surrounding, native vegetation, and are thought to be adventive (cf. Strother and Smith 1970).

All chromosome counts reported here were made from aceto-carmines squashes of microsporocytes from florets fixed in Carnoy's solution (6 vols. ethanol: 3 chloroform: 1 glacial acetic acid). Ten representative populations of *T. tenuiloba* var. *tenuiloba* are cited in table 1. Voucher collections for

TABLE 1. Chromosome counts in selected species of *Thymophylla*. Collection numbers (e.g., 619) are Strother's; numbers in parentheses indicate numbers of individuals of the ploidy-level indicated.

T. acerosa (DC.) Strother

Arizona. Cochise Co.: ca. 13 mi W of Willcox on road to Benson, 26 Apr 1968, 695, $2n = ca. 25$ (1). Texas. Culberson Co.: ca. 23 mi E of Van Horn along I-10 at Plateau exit, 25 Mar 1986, 1330, $2n = 24$ (1); Kinney Co.: ca. 2 mi S of county line on Rte. 277, 20 Apr 1968, 627, $2n = 8 \text{ II} + 2 \text{ frags.}$ (1); Pecos Co.: ca. 4 mi N-NE of Sheffield, near I-10 on Rte. 290, 25 Mar 1986, 1339, $2n = 24$ (1); Reeves Co.: ca. 6 mi E of I-20 on I-10 at Rte. 290 turnoff to Toyahvale, 25 Mar 1986, 1331, $2n = 24$ (1); Terrell Co.: ca. 13 mi W of Dryden, 20 Apr 1968, 619, $2n = 8 \text{ II}$ (1), $2n = 24$ (2); Val Verde Co.: just E of Comstock, 20 Apr 1968, 621, $2n = 8 \text{ II}$ (1).

T. pentachaeta (DC.) Small var. *pentachaeta*

Texas. Goliad Co.: ca. 1 mile SW of Goliad on Rte. 59, 29 Mar 1970, 848, $2n = 32$ (2); Starr Co.: ca. 8.5 mi E of Rio Grande City, 29 Apr 1969, 706, $2n = 16 \text{ II}$ (1); Val Verde Co.: just E of Comstock, 20 Apr 1968, 623, $2n = 16 \text{ II}$ (1).

T. tenuiloba (DC.) Small var. *tenuiloba*

Texas. Chambers Co.: I-10 at Rte. 146, 3 Jun 1976, 1227, $2n = 24$ (4); Dimmit Co.: ca. 4.6 mi NW of Carrizo Springs, 30 Apr 1969, 724, $2n = 8 \text{ II}$ (1), $2n = 24$ (13), $2n = 16 \text{ II}$ (4); Duval Co.: ca. 2.7 mi SW of Realitos, 29 Apr 1969, 713, $2n = 8 \text{ II}$ (4), $2n = 24$ (8), $2n = 16 \text{ II}$ (9); Llano Co.: ca. 8.7 mi E of Llano on Rte. 29, 2 May 1969, 747, $2n = 24$ (23); Mason Co.: ca. 12.5 mi E of Mason on Rte. 29, 2 May 1969, 749, $2n = 24$ (13); Nueces Co.: ca. 15 mi S of Robstown, 28 Apr 1969, 700, $2n = 8 \text{ II}$ (15); San Patricio Co.: ca. 4.5 mi S of Odem, 22 Apr 1968, 655, $2n = 24$ (9); Webb Co.: ca. 6 mi S of Laredo, 21 Apr 1968, 639, $2n = 24$ (1), $2n = 16 \text{ II}$ (5), $2n = 40$ (1); Willacy Co.: ca. 8 mi S of Sarita, 22 Apr 1968, 648, $2n = 8 \text{ II}$ (3), $2n = 24$ (4), $2n = 16 \text{ II}$ (2); Zapata Co.: ca. 4 mi W of Starr Co. line on Rte. 83, 29 Apr 1969, 709, $2n = 16 \text{ II}$ (20).

T. tenuiloba var. *treculii* (A. Gray) Strother

Texas. Maverick Co.: NE of Eagle Pass on loop, 30 Apr 1969, 726, $2n = 32$ (2), $2n = 40$ (4).

T. tenuiloba var. *wrightii* (A. Gray) Strother

Texas. Bee Co.: ca. 2.5 mi SE of Skidmore on Rte. 181, 22 Apr 1968, 657, $2n = 8 \text{ II}$ (1); Colorado Co.: ca. 3 mi W of Rock Island on Rte. 90A, 28 Apr 1969, 697, $2n = 8 \text{ II}$ (2); San Patricio Co.: 1 mile W of Sinton on Rte. 181, 22 Apr 1968, 656, $2n = 8 \text{ II}$ (9).

TABLE 2. Meiotic figures observed in a sample of 35 cells from a single triploid plant of *Thymophylla tenuiloba* var. *tenuiloba* (Strother 734G from Medina Co., Texas). (Numbers of cells per class in parentheses).

7 III + 1 II + 1 I (3)	4 III + 3 II + 6 I (1)
6 + 2 + 2 (9)	3 + 5 + 5 (4)
5 + 3 + 3 (6)	2 + 6 + 6 (1)
5 + 2 + 5 (1)	1 + 9 + 3 (1)
4 + 4 + 4 (8)	1 + 7 + 7 (1)

all 82 populations of *T. tenuiloba* var. *tenuiloba* sampled, including the 76 marked on figure 2, and for the other counts reported in table 1 have been deposited in TEX and/or UC.

As indicated in figure 2, diploids of *T. tenuiloba* var. *tenuiloba* are con-

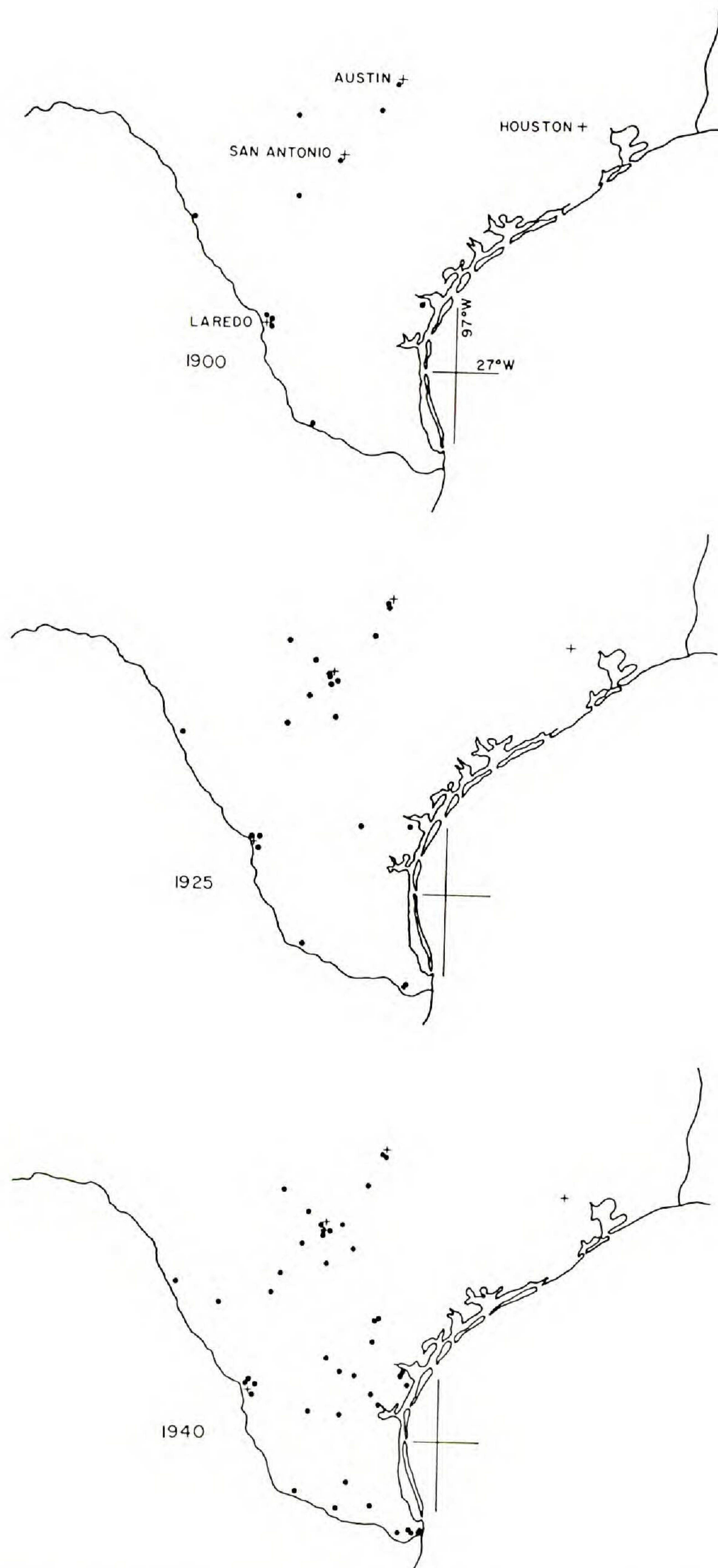
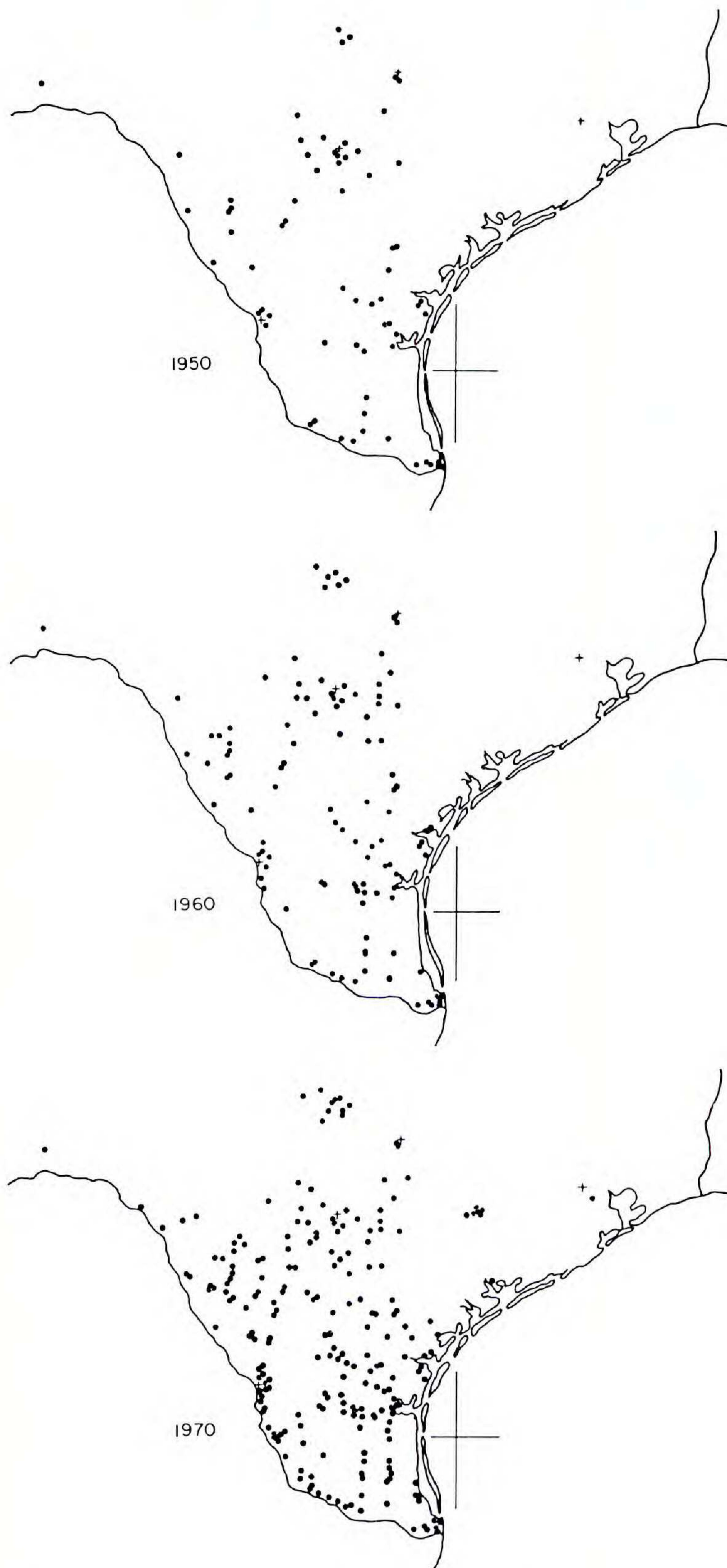


FIG. 1. Historical changes in distribution of *Thymophylla tenuiloba* var. *tenuiloba*. Range documented by collections made through ca. 1940 is thought to be the natural or native distribution of the taxon;



populations from beyond that range are thought to be adventive (cf. distribution of different ploidy-levels in fig. 2).

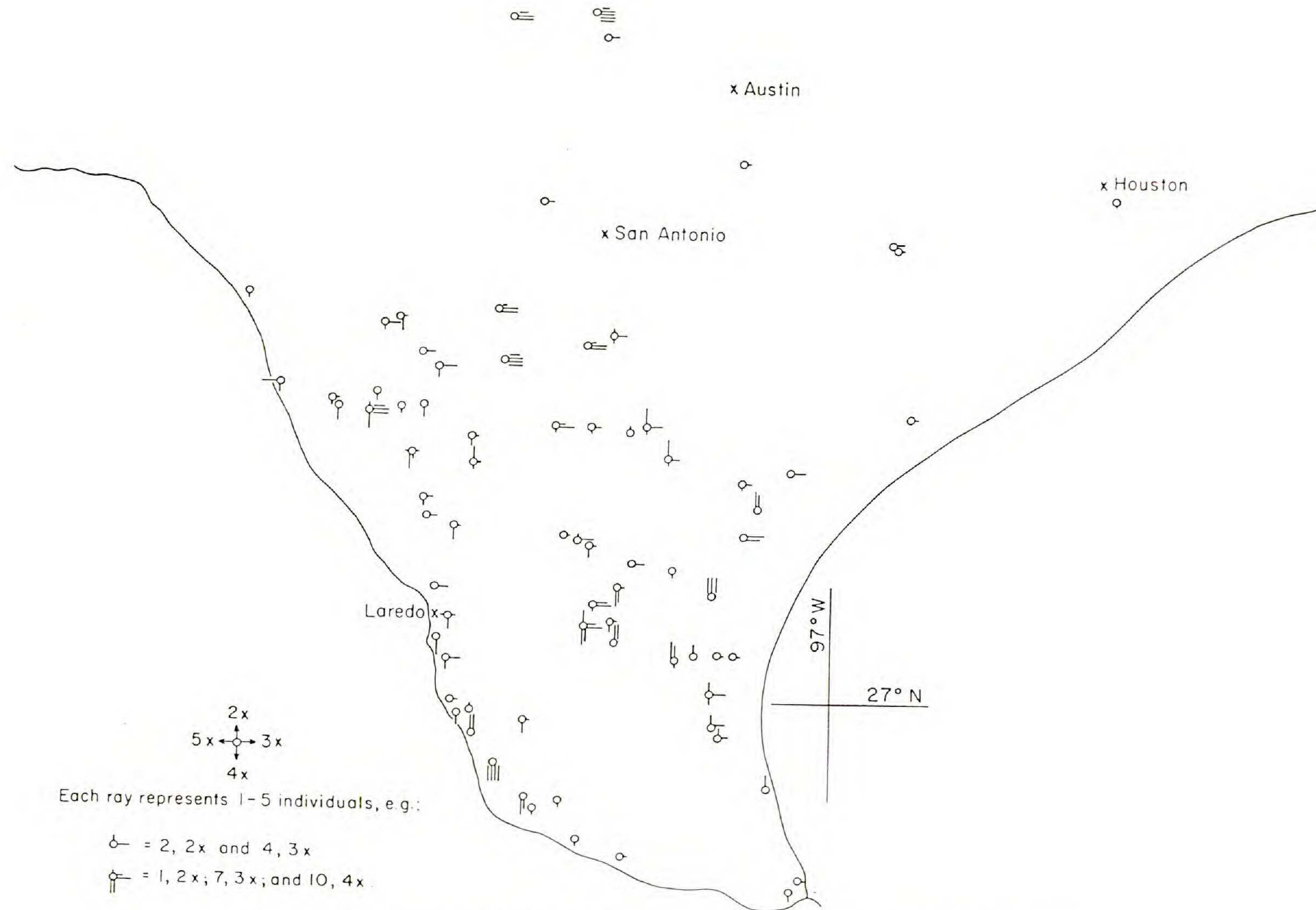


FIG. 2. Distribution of ploidy-levels in *Thymophylla tenuiloba* var. *tenuiloba* (cf. fig. 1).

centrated around the core of the distribution of the taxon and only triploids and other polyploids are found at peripheral and disjunct sites (i.e., in populations that are thought to be adventive, cf. fig. 1). That samples from some sites included individuals of more than one ploidy level, including some with both diploids and tetraploids, suggests that the origin of the triploid plants may well be polytopic. Of the 443 individuals of *T. tenuiloba* var. *tenuiloba* for which ploidy-level has been determined, 87 were diploid, 230 were triploid, 118 were tetraploid, and 8 were pentaploid.

Meiotic figures in the triploids include a considerable array of III's, II's, and I's at diakinesis and first metaphase, including, rarely, the maximal expected configuration: 8 III's. Sample observations from a single triploid plant are presented in table 2. Tetraploids often have quadrivalent associations. In none of the 1000's of cells in 100's of squashes made after I became aware of the triploids have I observed meiotic configurations of $2n = 13$ II or $2n = 26$ II in any plant referable to *T. tenuiloba*. During the same interval I have observed chromosomes of other species of *Thymophylla*; all have chromosome numbers based on $x = 8$ (table 1).

Acknowledging that one black sheep suffices to prove that the flock is not all white and acknowledging, too, that there are well-documented taxa with disparate chromosome numbers such as *Hymenoxys odorata* DC. (Sanderson and Strother 1973) and *H. texana* (J. Coulter & Rose) Cockerell (Strother and Brown 1988) and *Cevallia sinuata* Lag (Powell et al. 1977), I nevertheless submit that a reasonable inference from the observations summarized here is that all plants referable to *T. tenuiloba* have chromosome numbers based on $x = 8$ and that none has a chromosome number based on $x = 13$. While I cannot be quite so certain for the other species, I strongly feel that the same will prove true for all plants referable to *Thymophylla* (sensu Strother 1986).

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